practically no attention is necessary other than to occasionally note that the adjustment of the contacts conforms-to specifications.

A frosted appearance of the contacts indicates that they are making good contact with one another, and should not be disturbed as long as proper operation is maintained. The contact points are made of tungsten. This metal is too hard to file. Should it be necessary to dress them, an oil stone should be used. Care should be taken that they seat properly against each other and are correctly adjusted after being replaced.

It is a good plan after adjusting the timing contacts to check the ignition timing. See instructions under "Timing the Ignition."

IGNITION COIL

The ignition coil furnishes ignition current for the spark plugs. Low voltage current from the storage battery or generator is converted by the ignition coil into a current of high voltage which will jump the gap at the spark plug points. An ignition coil consists of an iron core made up of a bundle of soft iron wires around which and insulated from it is wound the primary winding. This consists of a few turns of comparatively heavy copper wire. Over the primary winding and insulated from it are wound several thousand turns of a very fine wire called the secondary winding.

When current from the storage battery or generator flows through the primary winding, it magnetizes the iron core, and when the current is interrupted by the timing contacts in the distributor, the magnetism dies out. A high voltage current is thereby induced in the secondary winding. One end of the secondary is connected to the high voltage terminal on the shell while the other end is connected to one end of the primary winding. It is from the high tension terminal of the coil that current is conducted to the distributor head, rotor and spark plugs.

TIMING THE IGNITION

The ignition system is carefully timed when the car leaves the factory. However, should it become necessary for any reason to retime the ignition, the following instructions should be closely followed:

1. Place the spark lever on the steering wheel in the fully retarded position.

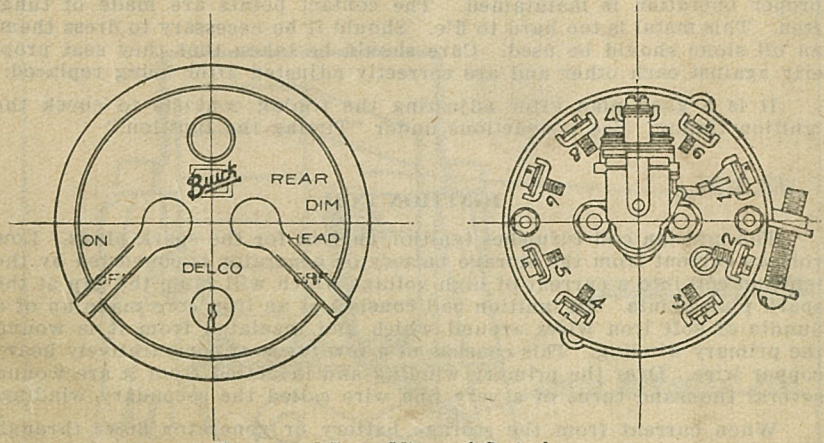
2. Turn the engine to the seven degree mark (which is approximately one inch after dead center), with the No. 1 cylinder on the firing stroke.

3. Loosen the timing adjustment screw in centre of the distributor shaft and breaker cam. Turn cam so that the rotor button will be in position under No. 1 high tension terminal when the distributor head is properly located. Locate the breaker cam carefully in this position so that when the back-lash in the distributor gears is rocked forward the contacts will be opened, and when the back-lash in the gears is rocked backward the contact will just close. The distributor shaft rotates clockwise when viewed from the top.

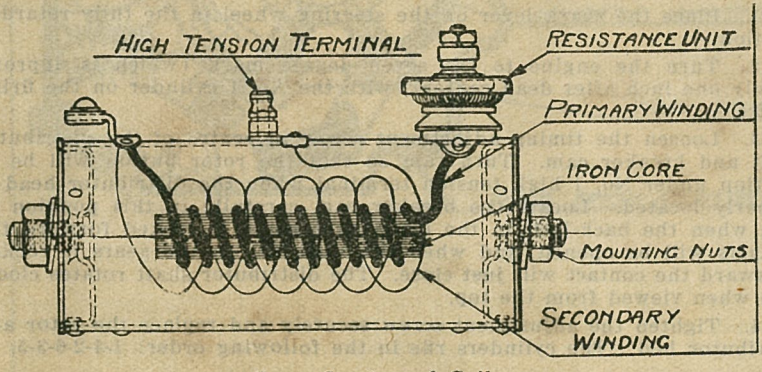
4. Tighten the adjustment screw securely and replace the rotor and distributor hed. The cylinders rfie in the following order: 1-4-2-6-3-5.

ADJUSTING SPARK PLUGS

The proper gap when adjusting the spark plug electrodes should be thirty-thousandths of an inch (.030"), or the thickness of the gauge on the Delco wrench marked "Spark Plug."



Front and Rear View of Switch



Cross Section of Coil

Plate No. 15

IGNITION AND LIGHTING SWITCH

A combination lighting and ignition switch is used to control the lighting and ignition circuits, and the circuit between the generator and the storage battery.

The left hand lever controls the ignition and the circuit between the generator and storage battery. By controlling the latter circuit it performs the function of an automatic cut-out which is commonly used for this purpose. For this reason this lever should not be left in the "ON" position when the engine is not running.

The lever at the right controls all lights except the cowl light which is operated by the button at the top of the switch. With the ignition lever in the "OFF" position, the switch may be locked with the lighting lever in any position except "HEAD."

CIRCUIT BREAKER

On the back of the combination switch is located the circuit breaker. This is a protective device which takes the place of fuses which are commonly used for this purpose. The normal current to the lighting circuits does not affect the circuit breaker, but in the event of an abnormally heavy current, such as would be caused by a ground on any of the lighting circuits flowing through the circuit breaker, it begins to function. This current causes the circuit breaker to operate and intermittently cut off the flow of current, thus causing an audible clicking sound which gives a distinctive warning that abnormal conditions exist in the circuit. This will continue until the ground is removed, or the switch is operated to cut off the circuit on which the ground exists. In this manner the circuit breaker protects the wiring, switch and storage battery. As soon as the ground is removed, the circuit breaker restores the circuit and there is nothing to replace.

AMMETER

Although the ammeter is not a part of the Delco equipment it is used in connection with the electrical equipment and permits the driver to keep a check on the performance of the electrical system. The instrument is for the purpose of indicating the net amount of current that the generator is supplying to the storage battery when the engine is running and indicates the amount of current that the battery is furnishing for lights when the engine is not operating.

At all car speeds faster than approximately 7 miles an hour with the lights "OFF," the ammeter should always indicate "charge." With the lights "ON," a slight discharge will be indicated at slow speeds. The lamp load will also reduce the charging rate at high speeds, as this load reduces the amount of current passing through the storage battery.

Should the ammeter indicate "discharge" with the engine running at normal driving speed without lights, it should be taken as an indication of trouble and the electrical equipment and wiring should be checked over by the dealer or at a service station having men trained in the handling of electrical work.

WIRING DIAGRAM

The internal wiring circuits of the electrical equipment are shown in the wiring diagram. (See Plate No. 16). Wth the aid of the diagram each circuit through the several units can be easily checked.

CAUTION

DO NOT ATTEMPT TO OPERATE THE SYSTEM WITH THE STORAGE BATTERY DISCONNECTED OR REMOVED FROM THE CAR. VERY SERIOUS DAMAGE TO THE APPARATUS MAY RESULT FROM SUCH ACTION.

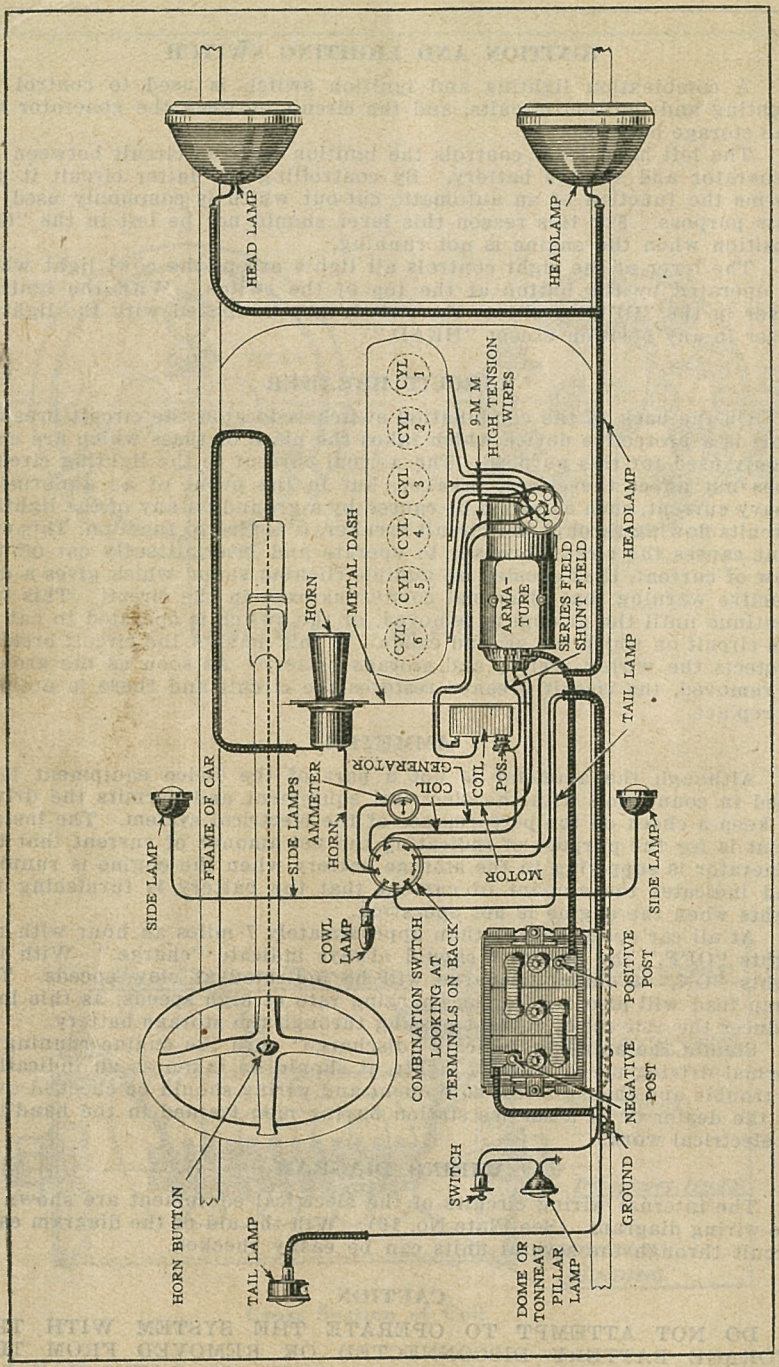
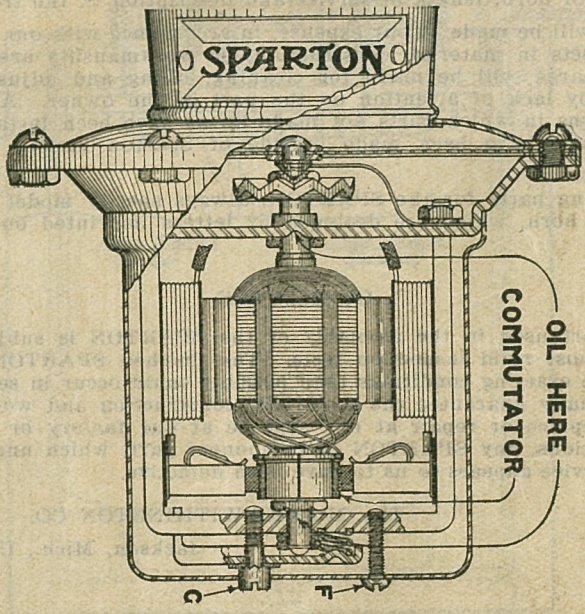


Plate No. 16
Wiring Diagram

DO NOT REMOVE THE MOTOR-GENERATOR OR ATTEMPT TO CHANGE ANY CONNECTIONS AT BACK OF THE IGNITION AND LIGHTING SWITCH WITHOUT FIRST DISCONNECTING THE LEAD ON THE NEGATIVE TERMINAL OF THE STORAGE BATTERY. THIS IS THE LEAD WHICH CONNECTS WITH THE FRAME OF THE CAR.

SPARTON ELECTRIC HORN



Care of Electric Spartons

EXPLANATION: The quality of tone and length of service of SPARTON Horns depends entirely on the care of them. To produce the distinctive SPARTON tone, it is necessary that the armature revolve at a high rate of speed. This speed is impossible unless the bearings are OILED and the commutator and brushes CLEAN. The armature and field coils may burn out if the armature sticks in the bearings due to lack of oil, and if proper contact with the commutator is prevented by dirt or corrosion on the brushes, the quality of the tone will be diminished on account of the reduction in speed of the armature, or the motor may fail to operate entirely.

LUBRICATION: Oil once each month using nothing but Three-in-one oil. Remove motor cover in rear and drop a few drops of oil at each end of the armature shaft in tbe oil hole, or grove indicated in illustration.

CAUTION: Do not use any oil except THREE-IN-ONE.

CARE: Commutator must be cleaned monthly. When motor cover is removed to oil, set motor in motion by pressing push button. Moisten a soft cloth in THREE-IN-ONE OIL and hold on commutator until clean.

ADJUSTMENT: Turn adjusting screw in rear end of motor cover (a

dime will serve as a wrench), to the right to tighten, to the left to loosen, until desired tone is atained.

CAUTION: Do not adjust too tightly. The armature should always turn easily, (when turned by the fingers).

IF THE SPARTON FAILS TO OPERATE: Don't take it apart—you may lose some essential piece. Do not remove the insulation between the commutator bars. Oil and clean carefully in accordance with the above instructions. If this does not cause it to operate, examine the wiring, battery and push button. If no trouble is apparent, send the SPARTON by parcel post, to the nearest Service Station, with letter giving make and model of horn, length of service and description of the trouble.

Repairs will be made at our expense, in accordance with our guarantee, if any defects in material, construction, or workmanship are apparent. Regular charge will be made for cleaning, oiling and adjusting made necessary by lack of attention on the part of the owner. Also for repairing horns in which parts not made by us have been installed or on which repairs have been made outside of Sparton factory or Service Stations.

In ordering parts for the SPARTON, always specify model and serial number of horn, which are designed by letters imprinted on the name plate.

GUARANTEE

Every part used in the assembly of the SPARTON is subjected to a series of most rigid inspection tests. The finished SPARTON is tested under more exacting conditions than possibly could occur in service. We unconditionally guarantee the materials, construction and workmanship. We will replace or repair at our expense at our factory or authorized service stations, any SPARTON or component part, which under normal use and service appears to us to have been defective.

The SPARKS-WITHINGTON CO.

Jackson, Mich., U.S.A.

RADI-METER.

The face of this instrument is calabrated and the fahrenheit degrees marked in figures. Above these figures there are three colored zones. The white zone covers the degrees at which the motor is too cool for satisfactory results in running. The yellow zone shows the degrees at which the motor would run most satisfactorily, while the red zone shows the degrees at which the motor is too hot and in danger of being damaged if allowed to run at that temperature. The owner should investigate the motor at once and try and determine the cause of the motor heating up to that degree. This condition may be due to any of the following causes:—

Lack of water for proper cooling.

Timing of motor may have slipped, causing same to fire too late.

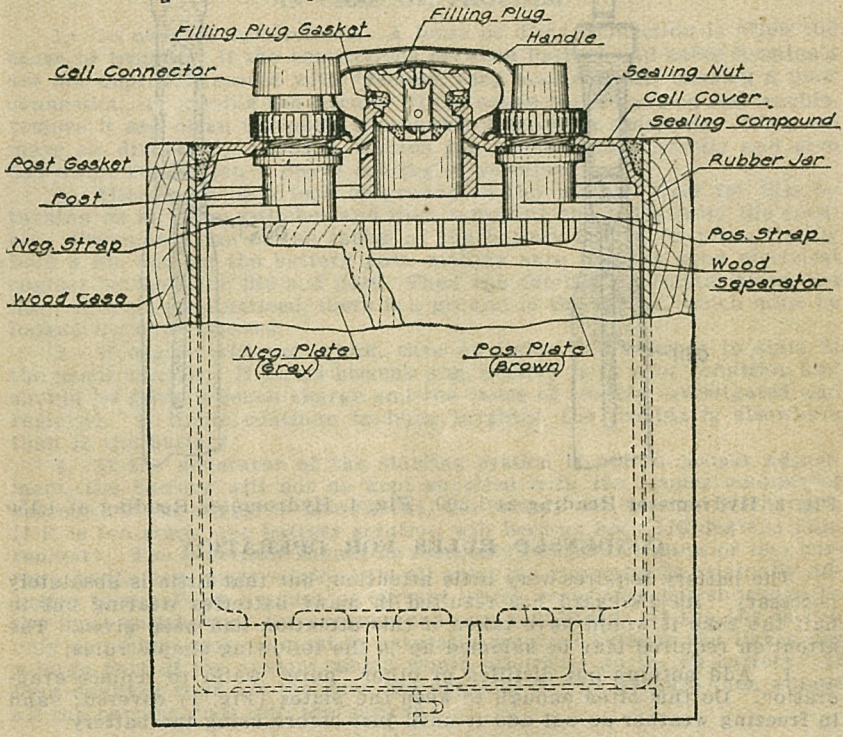
Too rich a mixture of gas.

CAUTION—When anti-freeze mixture is used in the radiator it must be taken into consideration that the boiling point of this mixture is much lower than the boiling point of water (boiling point of alcohol is about 170), and care must be taken in reading the radi-meter to allow for the difference in the mixture according to the proportion of the alcohol in the mixture in the cooling system.

STORAGE BATTERY

McLaughlin six cylinder cars are equipped with a 6 volt, 15 plate Exide battery, Type 3-XC-15-1.

Fig. 1. Battery Cut Away to Show Construction

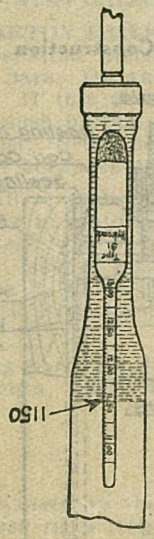


BATTERY GUARANTEE

The Exide Batteries are guaranteed by the manufacturers Exide Batteries of Canada, Ltd., Toronto, Ont., to be free from defects in material and workmanship.

At any time within three months from date of delivery to the purchaser any battery which may prove to be defective or incapable, when fully charged, of giving its rated capacity, will be repaired or replaced free of expense on receipt, transportation charges prepaid, at any authorized Exide Battery Service Station. This guarantee does not cover the free charging of batteries, nor the making good of damage resulting from continued lack of charge, nor from failure to keep the plates covered with solution by filling the cells from time to time with pure water. No claims on account of alleged defects can be allowed unless made within three months of date of delivery of battery to purchaser, and the right is reserved to refuse to consider claims in the case of batteries opened by other than authorized Exide Battery Service Stations.

Purchasers of cars equipped with Exide Batteries are earnestly urged to co-operate with the battery manufacturers by taking their cars, as promptly as possible after receipt, to the nearest Exide Battery Service Station in order that the battery may be tested and its condition and installation checked. No charge is made for this inspection.



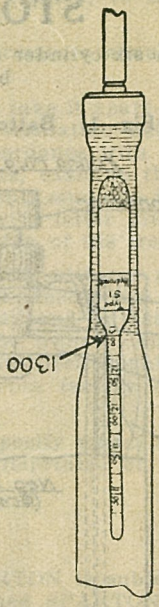


Fig. 3. Hydrometer Reading at 1.300. Fig. 4. Hydrometer Reading at 1.150

CONDENSED RULES FOR OPERATION

The battery requires very little attention, but that little is absolutely necessary. Its disregard has resulted in many batteries wearing out in half the time it would have taken if this attention had been given. The attention required may be summed up in the following simple rules:

1. Add nothing but distilled or other "pure" water to replace evaporation. Do this often enough to keep the plates (Fig. 1) covered; and in freezing weather do not add it until just before using the battery.

2. Keep the connections tight and covered with vaseline.

3. Keep the filling plugs tight and the battery dry and clean.

4. Take Hydrometer readings every month at any time except just after adding water, and **be guided by their indications**, as follows:

(a) Readings less than 1.225 [1.155*], but more than 1.150 [1.080*], indicate a battery less than half-charged. Use lamps and starter sparingly until the readings become more than 1.250 [1.180*].

(b) Readings less than 1.150 [1.080*] indicate complete discharge; in which case the battery should be given a bench charge. This discharged condition may be due to need of adjustment in the system. To determine this, follow the rules below and on next page and remedy the cause before again running the car.

(c) If the reading of one cell differs from the others by 50 points or more, it indicates that the cell is not in good order. Take the battery to a skilled service station for attention.

5. If the car is to be laid up for the winter, take the battery to a skilled service station for proper storage.

6. If repairs are necessary, take the battery to a skilled service station. Do not entrust it to inexperienced or unskilled hands.

*The reading in brackets applies to batteries used in climates where freezing of water never occurs.

SERVICE STATIONS

Exide Battery Service Stations are maintained in principal cities and towns throughout the country to assist you to obtain good service from your battery. Do not entrust your battery to the care of a novice.

IN CASE OF TROUBLE

1. Go over all connections. A loose or dirty connection is often the cause of trouble. If the connections between battery and cable termina's are not kept well coated with vaseline, they may corrode, causing a poor connection, or opening the circuit. If the connector is causing the trouble, remove it and clean the parts thoroughly with weak ammonia. Then remove all dirt, apply vaseline, tighten the connections perfectly and give the whole connection a heavy coating of vaseline.

2. There may be a leak or ground in the wiring. Test for this by turning on all lamp switches and then removing the bulbs from the sockets. Disconnect one of the cables at the battery and in its place tightly hold a file against the battery post, making sure there is good electrical contact between the file and post. Then rub the cable terminal along the file; if sparks are noticed, there is a ground in the wiring, which must be looked for and removed.

3. If engine will not crank, turn on lights and attempt to start in the usual manner. If lights become dim, battery is in poor condition and should be given a bench charge and the cause of trouble investigated and removed. If lights continue to burn brightly, the trouble is elsewhere than in the battery.

4. If the generator of the starting system is not in proper adjustment, the battery will not be kept supplied with the proper amount of current. If the supply is insufficient, the battery will become discharged. If it is too much, the battery solution will become hot (110 degrees Fahrenheit). The generator should be readjusted to deliver more or less current, as the case may require. On all cars, the generator is originally adjusted to supply an amount of current which experience has shown to be the most satisfactory for average running conditions. If the car is run only at nights, more current is naturally required because the lights use a large part of the current which would otherwise go to the battery. If long daylight runs are the rule, the opposite is true because then almost all the current goes into the battery.

ADDING WATER

The solution in the battery is a mixture of pure water and pure sulphuric acid. Water evaporates; sulphuric acid does not. This is one reason why it is necessary to add water, and also why it is unnecessary to add acid. Another reason is that whenever the battery gases or bubbles, the action going on changes some of the water into gas which escapes. The acid is not so affected.

Add water often enough to keep the plates covered. There is a certain space above the top of the plates for holding a quantity of solution, and this may be regarded as a reservoir, the object being to keep it from becoming empty or, in other words, to keep the plates from being exposed. Just how long the supply will last depends on several conditions, among which is temperature. Water will be required more frequently in summer than in winter. It is a good plan to add water at least once a week in summer and every other week in winter. When long daylight runs are made, water must be added still more frequently.

In warm weather, it makes no difference when water is added. In freezing weather, it should be added just before using the car. The reason is that water will remain on top of the solution until it is mixed with it by action of the battery. If not mixed with the solution, it would freeze almost as quickly as outside the battery.

"PURE" WATER

By "pure" water is meant water which contains nothing injurious to the battery. Water may be excellent for drinking and yet contain something injurious to the battery. Distilled (but not merely boiled) water, melted artificial (but not natural) ice or rain water (if obtained in the open country from a clean slate or shingle-covered roof) are generally satisfactory.

All water for battery use should be kept in clean, covered vessels of glass, china, earthenware, rubber or lead.

HYDROMETER READINGS

Hydrometer readings should be taken with an instrument called a "hydrometer syringe" by inserting the end of the syringe in a filling tube and drawing up enough solution to float the glass bulb inside the instrument. The reading of the scale at the surface of the liquid gives the strength of the solution. (See Fig. 3 and 4).

Hydrometer readings should be taken at least every month and may be taken at any time except in the interval between adding water and operating the battery. During this interval the water just added has not been mixed with the solution and the hydrometer reading would show but little more than the strength of this water.

CLEANLINESS

It is very important. Dampness or dirt on the battery permits the electric current to leak away and attracts and holds small quantities of battery solution which in time accumulate sufficiently to corrode terminals and rot the wood case.

If a battery has become wet, before drying it, go over it with a rag dampened with ammonia solution. This will counteract the effect of the battery solution.

Battery connections are made of metal parts, heavily coated with lead to prevent exposure to corrosion. If the coated metal becomes exposed, corrosion may appear. To guard against this, the terminals should be kept heavily coated with vaseline. If corrosion should appear, remove it and clean the parts thoroughly with weak ammonia. Then apply vaseline. Also be sure the connections are kept tight.

STORING STORAGE BATTERY

Remove storage battery by disconnecting both positive and negative leads from battery. Take Hydrometer reading of solution to ascertain that battery is in the fully charged state (Specific gravity 1.285); add pure distilled water necessary to bring solution ½" above plates, being sure to thoroughly mix the water added with the solution contained in the battery.

Replace filler plugs, apply a thorough coat of vaseline to terminals, nuts and washers, which will prevent corroding. Place battery in a room where the temperature will always be above freezing. This is important. Once a month remove plugs and bring solution to ½" above the plates by adding distilled water as before. Take hydrometer reading, and if specific gravity has fallen below 1.260, have battery charged to bring it back to fully charged state.

STORING CAR FOR WINTER

If car is to be placed in storage during the winter months, the following instructions should be carefully adhered to:

Wash and dry car thoroughly, using a pure soap, cold water and soft chamois; a soft cloth saturated with kerosene (coal oil) will be found con-

venient to remove any surface grease from motor metal parts. With top in the fully raised position, place car in dry place, free from dust. By some convenient method, jack car up, so weight is entirely removed from all wheels, deflate tires to a few pounds pressure. Drain all water from radiator, engine and water pump, by removing plugs and opening petcocks. Drain all oil from engine by opening drain cock in lower half of crank case. Insert a few drops of lard oil around each valve stem; also pour a tablespoonful of lard oil on top of piston, through spark plug hole, and replace spark plugs. Be sure water is thoroughly drained from all parts.

PUTTING CAR INTO SERVICE

In putting the car into service in the Spring, care should be taken to see that all parts are in proper working condition before attempting to use car. First inflate tires to proper pressure. See that radiator is filled with clean water; that crank case is filled with engine oil and the oil level is no higher than petcock opening. See that spark plugs are clean and free from carbon.

Connect Storage Battery by replacing Positive and Negative leads. Insert a few drops of engine oil in all oil holes, fill grease cups with fresh grease; apply a few drops of kerosene to each valve stem and make sure fan is working properly. It is advisable to turn engine over a few times with the hand crank to make sure all moving parts are free before attempting to use the self-starter. Transmission and differential should be carefully inspected to see that they contain the proper amount of oil. Storage battery should be in the fully charged state (specific gravity 1.285) and solution ½" above plates.

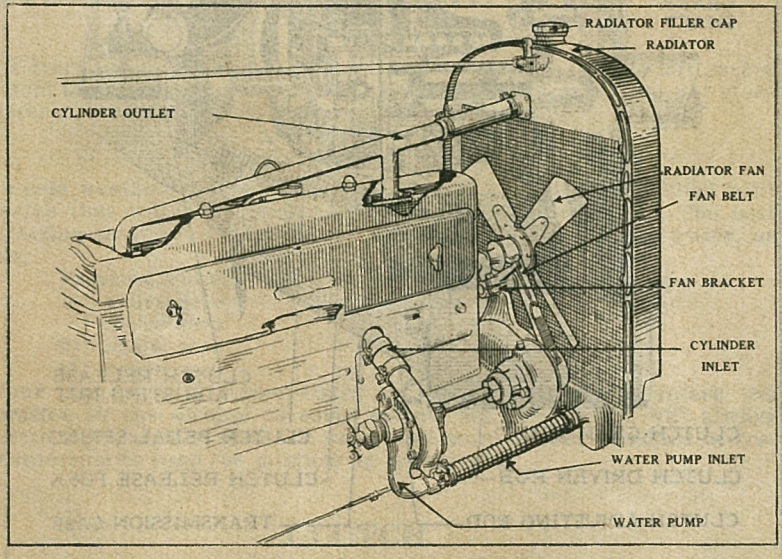


Plate No. 17
Cooling System

COOLING SYSTEM

The cooling system includes the radiator, water circulating pump, water connections and radiator fan.

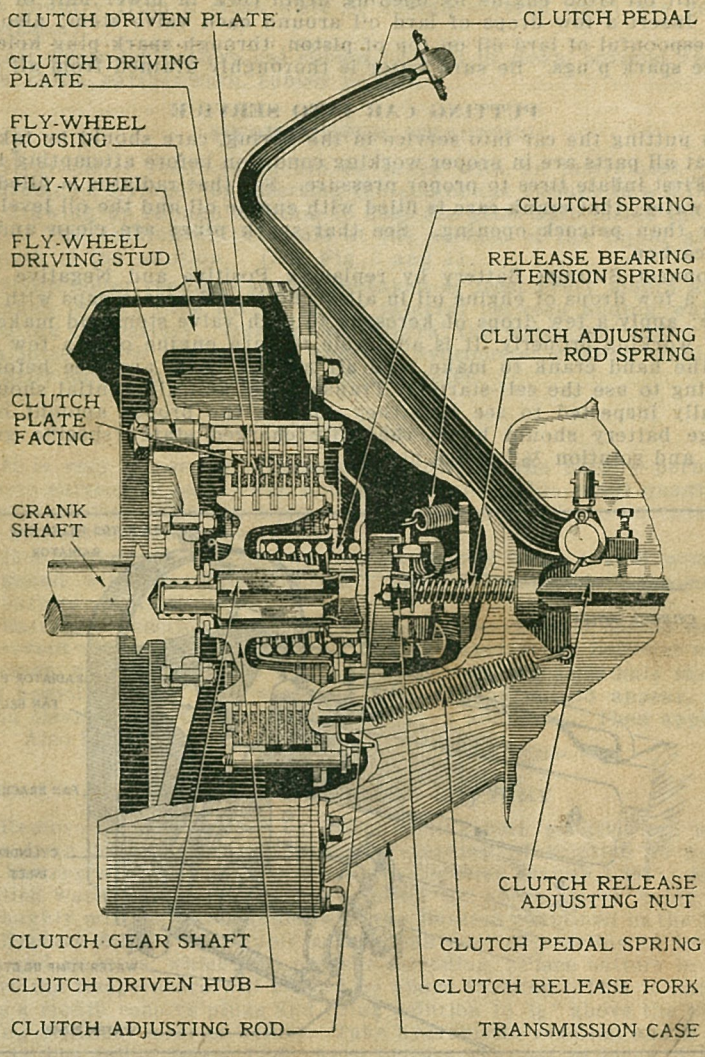


Plate No. 18
Clutch

RADIATOR

The radiator consists of an upper and lower tank connected by a large number of narrow passages in the cellular core. The hot water from the engine enters the upper tank and gradually flows through the passages in the core to the lower tank while a current of cool air is circulated through the opening in the core by the radiator fan. An enameled shell encloses the radiator and supports it on the frame of the car.

WATER PUMP

The water pump is of the centrifugal type and consists of an impellor with straight blades, fastened to the shaft, and a loose fitting, air tight casing, with inlet and outlet connections, fastened to the engine crank case. As the impellor revolves, it draws water from the radiator to the center of the impellor and by centrifugal force, throws it off at the outer ends of the blades and out of the casing to the cylinder jackets.

In order to keep the casing air tight the pump shaft is carried in glands, filled with prepared wick packing which also acts as a lubricant. These glands should be tightened from time to time as they show indications of leakage, but care must be taken to keep them from binding the shaft.

RADIATOR FAN

The radiator fan is mounted on the front end of the engine and is driven by belt from the cam shaft. It should be lubricated at intervals by introducing engine oil through the plug hole on fan hub. The belt can be tightened by screwing down wing nut or adjusting screw.

To prevent overheating keep radiator filled with clean water, see that fan belt is tight, and avoid leaky connections.

DRAINING

To drain cooling system, open drain valve at inside lower left corner at bottom of radiator and open drain cock in water pump. Do not store car without draining cooling system thorughly.

ANTI-FREEZING MIXTURE

In cold weather, the cooling system should be drained and filled with a solution that will not freeze when car is allowed to stand. The best anti-freezing mixtures are composed of denatured alcohol and water, as follows:

Freezing Point	Alcohol	Water
10° above zero	20%	80%
5° above zero	20%	70%
20° below zero	40%	60%
35° below zero	50%	50%

Four ounces of glycerine added to these mixtures will retard the evaporation of the alcohol to some extent, but the alcohol will always evaporate more rapidly than the water and more should be added at frequent intervals to keep the mixture up to strength.

CLUTCH

A gasoline engine cannot be started under load and for this reason the engine is connected to the driving mechanism by means of a friction clutch which can be released by pressing down on the clutch pedal.

The clutch consists of a series of steel plates operating between steel plates faced with asbestos friction material, which are connected alternately to the fly wheel and to the clutch shaft of the transmission. When the clutch is engaged, a spring forces the plates together so that they re-

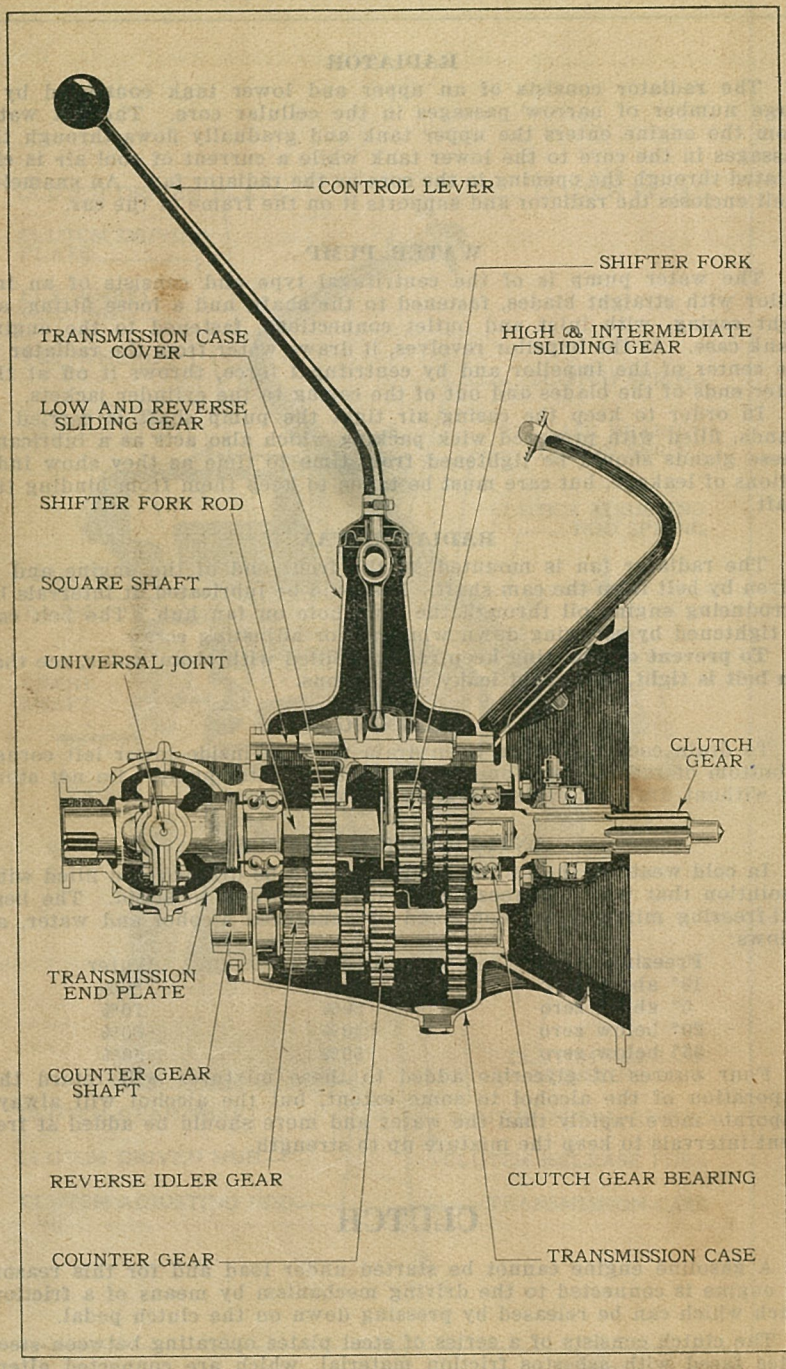


Plate No. 19
Transmission

volve as a unit with the fly wheel of the engine, but when the clutch pedal is pressed down the plates separate, those connected to the fly wheel continuing to revolve while those connected to the transmission are stopped.

ADJUSTMENT OF CLUTCH

In the course of time the friction facing on the clutch discs will wear and when this occurs the clutch should be adjusted to prevent slipping. Adjustment can be made by moving lock nut and adjusting nut on clutch release rod to allow more clearance between the clutch release bearing and the plates. When properly adjusted there should be 1/32" clearance between the ball thrust bearing and the rear plate against which it operates.

The position of the clutch pedal can be adjusted by means of the set screw in the rear end of the clutch pedal.

Do not put any oil or grease on the clutch discs.

The clutch operating parts are lubricated by two Alemite fittings, one located on the clutch release yoke pin and one on the clutch release bearing retainer, both of which should receive attention at least once every 500 miles. A few drops of oil applied to the pins on which the discs slide will prevent squeaking.

EXHAUST SYSTEM

The exhaust system includes the exhaust manifold, exhaust pipe and muffler.

The muffler conists of three concentric sheet metal drums which are perforated at opposite ends, so that the gas is compelled to travel the full length of each drum in turn while it is expanding and losing its heat.

In the muffler elbow a plug is provided principally to test the firing of the engine and this plug should never be removed for use as a warning signal or for amusement. Removal of this plug will not materially increase the power of the engine.

The exhaust system requires no attention on the part of the driver.

TRANSMISSION

The transmission system includes all those parts which transmit power from the engine to the rear wheels, but generally the transmission gearset alone is described by this term.

GEARSET

The gearset, or change speed gear, is made necessary on account of the fact that a gasoline engine develops power in proportion to its speed; the higher the speed, the greater the power output. On the other hand the car frequently requires more power at low speeds than at higher and at such times the gearset is used to change the ratio between the speed of the engine and the speed of the rear wheels.

The change speed gears are carried on two shafts, the lower of which is known as the countershaft and carries the counter gears, while the upper or main shaft carries the sliding gears. The main shaft is mounted

in a ball bearing at its rear end and runs in a bearing in the clutch gear at its forward end.

The counter shaft is stationary and the counter gears revolve on it. The reverse idler gear is mounted on a separate shaft to one side of countershaft and is in constant mesh with the countergear. The sliding gears are mounted on the main shaft in such a manner that they can be moved along to engage with one or the other of the countergears.

The high and intermediate sliding gear is provided with internal teeth on its forward side so that it can be moved over the clutch gear to lock the main shaft and clutch gear together.

All the gears run in a constant bath of oil which also lubricates the bearings of the main shaft, clutch gear and universal joint. An oil filler hole is provided on the side of the transmission case for introduction of new oil, and a drain plug at the bottom allows emptying and cleaning.

NEUTRAL POSITION

The clutch gear is directly connected to the engine and consequently turns in the same direction, but the countergear, being in constant mesh with the clutch gear revolve in the opposite direction. When the control lever is in neutral position, neither of the sliding gears is in mesh with any other gear and therefore the main shaft does not turn.

FIRST SPEED POSITION

When the control lever is moved to the first speed position, the low and reverse sliding gear is slid into mesh with the counter-gear and the car moves forward; but owing to the fact that the power is being transmitted from the smaller to larger gears, the rear wheels of models 22-44, 22-45, 22-46 and 22-47 make approximately one revolution for every 15½ revolutions of the engine, and the models 22-48, 22-49 and 22-50 make approximately one revolution for every 16½ revolutions of the engine.

SECOND SPEED POSITION

When the control lever is moved to the second speed position, the low and reverse sliding gear is drawn out of mesh with the countergear and the high and intermediate sliding gear is moved back into mesh with the intermediate speed counter gear. In this position the main shaft also turns in the same direction as the engine but the rear wheels of models 22-44, 22-45, 22-46 and 22-47 now make approximately one revolution for every 8⅛ revolutions of the engine, and the models 22-48, 22-49 and 22-50 make approxmately one revolution for every 8⅝ revolutions of the engine.

HIGH SPEED POSITION

When the control lever is moved to third, or high speed position, the high and intermediate sliding gear is moved forward on the main shaft until the internal teeth slip over and engage the teeth of the clutch gear, locking the main shaft and clutch gear together, thus giving the engine a "direct drive" to the rear axle. The rear wheels of models 22-44, 22-45, 22-46 and 22-47 now make approximately one revolution for every 4⅝ revolutions of the engine, and the models 22-48, 22-49 and 22-50 make approximately one revolution for every 4⅞ revolutions of the engine.

REVERSE POSITION

Moving the control lever to the reverse position slides the low and reverse sliding gear back into mesh with the reverse idler gear which in turn meshes with countergear, the main shaft now turns in the opposite direction of the engine, driving the car backwards. In this position the rear wheels of models 22-44, 22-45, 22-46 and 22-47 make approximately one revolution for every 19⅞ revolutions of the engine, and the 22-48, 22-49 and 22-50 make approximately one revolution for every 21⅛ revolutions of the engine.

CONTROL LEVER

The sliding gears are moved back and forth on the main shaft by means of shifter forks which are carried on a rod in the transmission cover. The control lever is pivoted in the cover so that it may be swung to one side or the other. When swung to the right it picks up the fork which moves the low and reverse sliding gear, and when swung to the left it operates the high and intermediate sliding gear. Small spring plungers in the sides of the cover engage with slots in the shifter forks to hold the sliding gears in position.

UNIVERSAL JOINT

The transmission gearset is fastened solidly to the engine, which in turn is fastened to the car frame, but the rear axle is hung on springs and must be free to follow the uneven surface of the road. In order to allow continuous transmission of power from the gearset to the rear wheels, the universal joint is interposed between them. It consists principally of a split ring having four bearing surfaces. A yoke attached to the main shaft of the gearset is assembled into two of these bearing surfaces, while the splined yoke that slips on forward end of axle is assembled into the other two bearing surfaces. The joint is enclosed in a spherical housing and is automatically lubricated by oil from the transmission.

SPEEDOMETER

The speedometer registers the speed at which the car is travelling, the total number of miles traveled, and the trip mileage. The total cannot be reset, but the trip mileage can be reset to zero by pulling out and turning the knurled finger nut backward or forward, which protrudes through the face for that purpose.

If the speedometer head is removed for any reason, handle it as you would a fine watch, as the head is made up of such intricate parts that it can easily be damaged by rough handling.

The drive is taken from a worm gear which is attached to the main shaft of the transmission through the transmission end plate, being supported with suitable bearings and held in place by a set screw.

The drive shaft is enclosed in a flexible tube which is attached with a nut at either end and can be lubricated by removing; unhook at lower end of chain and pull chain clear of the tube from opposite end. Then smear chain freely with a good quality of cup grease twice a year. And under no circumstances should the instrument head receive oil.

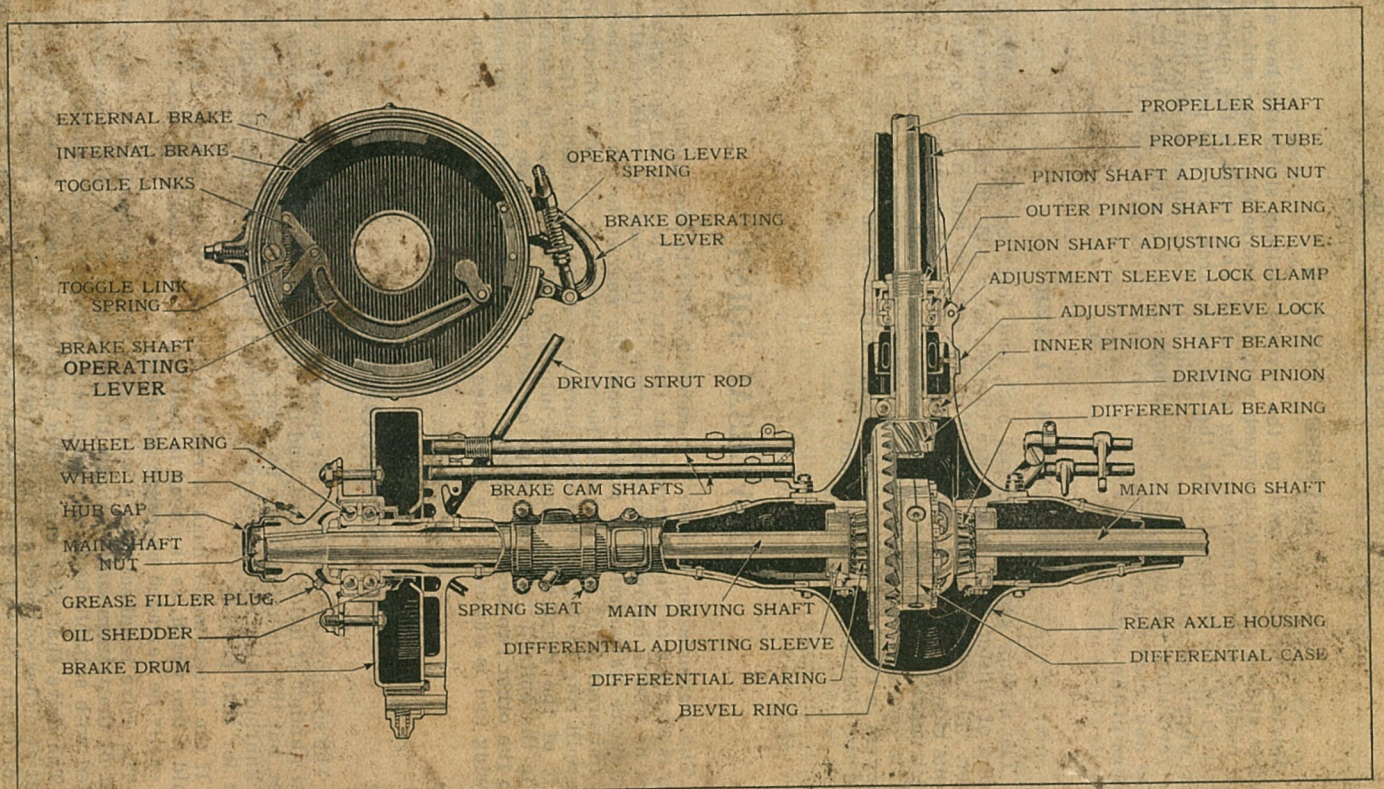


Plate No. 20
Rear Axle

REAR AXLE

The rear axle assembly includes the propeller shaft, differential, axle shafts, brakes and wheels and constitutes the final element in the driving mechanism.

PROPELLER SHAFT

The propeller shaft transmits the power from the universal joint to the driving gears of the differential. It is enclosed for its entire length in a steel tube carrying the driving flange which attaches to the universal joint housing on the rear of transmission. The driving effort from the rear wheels is transmitted by the pinion tube through the ball joint to the transmission case and the frame of car. The pinion tube also absorbs the torque reaction of the bevel driving gears. At its rear end the propeller shaft is mounted on ball bearings and carries the driving pinion which meshes with the large ring gear on the differential.

The depth to which the pinion meshes with the teeth of the ring gear is adjustable and adjustment can be made by removing the cover plate on the right side of the pinion flange and loosening the adjusting sleeve clamp screw on the right side. The sleeve which carries the outer bearing can then be turned to adjust the position of the pinion.

Adjustment of the pinion shaft should be made only by an experienced mechanic. In case of trouble, take car to the nearest McLaughlin dealer or service station.

DIFFERENTIAL

The differential equalizes the amount of power applied to each of the rear wheels and allows one wheel to travel faster than the other wheel when the car is rounding a curve. It consists of a case mounted on tapered roller bearings which hold it in position. The large driving ring is attached to the outside of the case and meshes with the driving pinion. Inside of this case is a set of four bevel gears, all of which mesh with the side or intermediate pinions, into which the main axle shafts slide from the outside, they being connected to the rear whieels.

When the car is being driven straight ahead, the differential gears lock themselves and revolve with the motion of the case as a solid unit.

When the car turns a corner, the inside wheel slows down retarding its main shaft and the intermediate gear to which it is connected in the differential, but since the engine continues to drive the differential case at the same speed, the side pinions begin to revolve on their bearings, thus increasing the speed of the outside wheel.

The position of the differential and driving gear with respect to the driving pinion can be adjusted by removing the cover plates on each side of the housing at the rear and turning the adjusting sleeves. Both sleeves must be turned the same amount and in the same direction to prevent any end play in the differential bearings.

The differential bearings are the taper roller type and should be so adjusted that the differential will rotate freely without any perceptible end play or shake. These bearings are adjustable for wear and any excessive amount of wear that may develop would probably occur in the first 1,000 miles, and examination should be made of these bearings after a run of this distance.

The differential and its bearings run in a continual oil bath introduced through the filler plug in the axle housing. The old oil should be drained off, differential washed out with kerosene and fresh oil introduced twice a season.

Adjustments should be made by an experienced mechanic and in case of trouble, car should be taken to nearest McLaughlin dealer or service station, and the following directions will assist in adjusting the Rear Axle Spiral Bevel Gears.

SECTION OF SPIRAL TOOTH RING GEAR

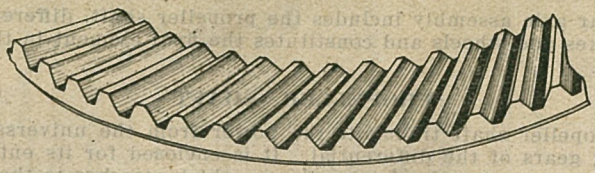


FIG. 1

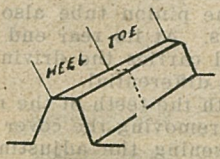


FIG. 2

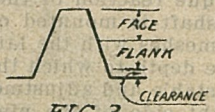


FIG. 3.

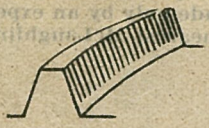


FIG. 4.

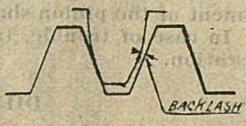


FIG. 5

FIG. 6.

FIG. 7.

FIG. 8

FIG. 9

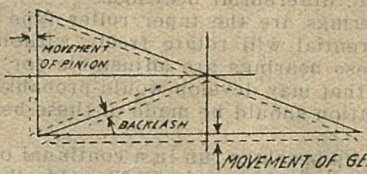


FIG. 10.

Plate No. 21
Sections of Ring Gear and Pinion

INSTRUCTIONS FOR ADJUSTING SPIRAL BEVEL GEARS IN REAR AXLE

In order that the Spiral Bevel Ring Gear and Pinion may operate correctly, the rear axle must be in perfect alignment. That is, the differential axis must be in the same plane as the pinion axis. If there is any variation at all, the pinion axis must not be above the gear axis, as that would throw the contact or load on the heel of the tooth.

It is very important that a careful inspection of the bearings be made before they are put back in their respective positions. If single row ball bearings are used, they may have a little angular movement, but must not have any radial play. By angular movement, we mean a slight rock; an action which we get in a ball joint. By radial movement we mean straight movement up and down. If the bearings are laid on a surface plate and you can move the cone straight over against the outer race and notice much play that way, the bearings should not be used. Also, make sure that the balls are not damaged. If they spin freely, no doubt they are all right. If the bearing sticks, clean it carefully with gasoline to make sure that all foreign matter is removed. Also try and keep them in a clean place.

If the bearings are of the roller type, examine the rolls and make sure they are not pitted or worn too bad. Also inspect the linings or cups which fit into the differential or pinion housing. If these are pitted or excessively worn, they should be replaced with new parts.

Make sure that all parts which go on the inside of the gear housing are thoroughly cleaned. Any chips, grit or other hard substances grind out the bearings and gears very quickly. All studs and nuts must be a good fit in threads, so as to hold the gears and bearings in place. If these are loose, they will let the gears vibrate, and they will probably go to pieces in a very short time.

In mounting ring gear on differential, inspect ring gear seat of differential case to determine whether it runs true with the bearing hubs. If it runs out more than .002", face it off in lathe to make it run true. When riveting ring gear on case, make certain that it is riveted tight. Ring gear should not run out more than .008", using the bearing hubs of the differentials as centers.

When driving pinion on shaft, see to it that it does not ride the key, also that it is driven on tight. Pinion must not run out more than .004" on shaft.

The most common method of setting up Spiral Bevel Gears, is to set ring gear and pinion so they come flush, either at large or small end of the teeth, and have an operating clearance of from .005" to .008". For perfect adjustment, however, this method must be forgotten. An experienced mechanic can very often locate the proper running position by his sense of touch, but even that is not always dependable. This method is not correct at all times. This depends largely on the cut of the gear and the variation that takes place in its manufacture.

When the mechanic is ready to place the gears back into the axle, the best way to do is to roll the pinion around the ring gear by hand and note the position which the pinion takes at the large or small end, whether it sticks out or runs in. Assemble them in the axle as near as you can, in that position, allowing from .005" to .008" back lash between them. Place the axle under the car, and at the same time paint the gear teeth with a thin coat of white lead. After this is done jack up the rear wheels and start the engine, throwing transmission into high gear, also throw in your brake, which must be equalized so you can get about the same load on each wheel. This will wipe the paint off the teeth. You may find a condition as illustrated in Figure 9. The shaded portion represents the contact of your gear. That means the load is pulling on this portion of the teeth. In that case, move your pinion in, or toward the rear, two,

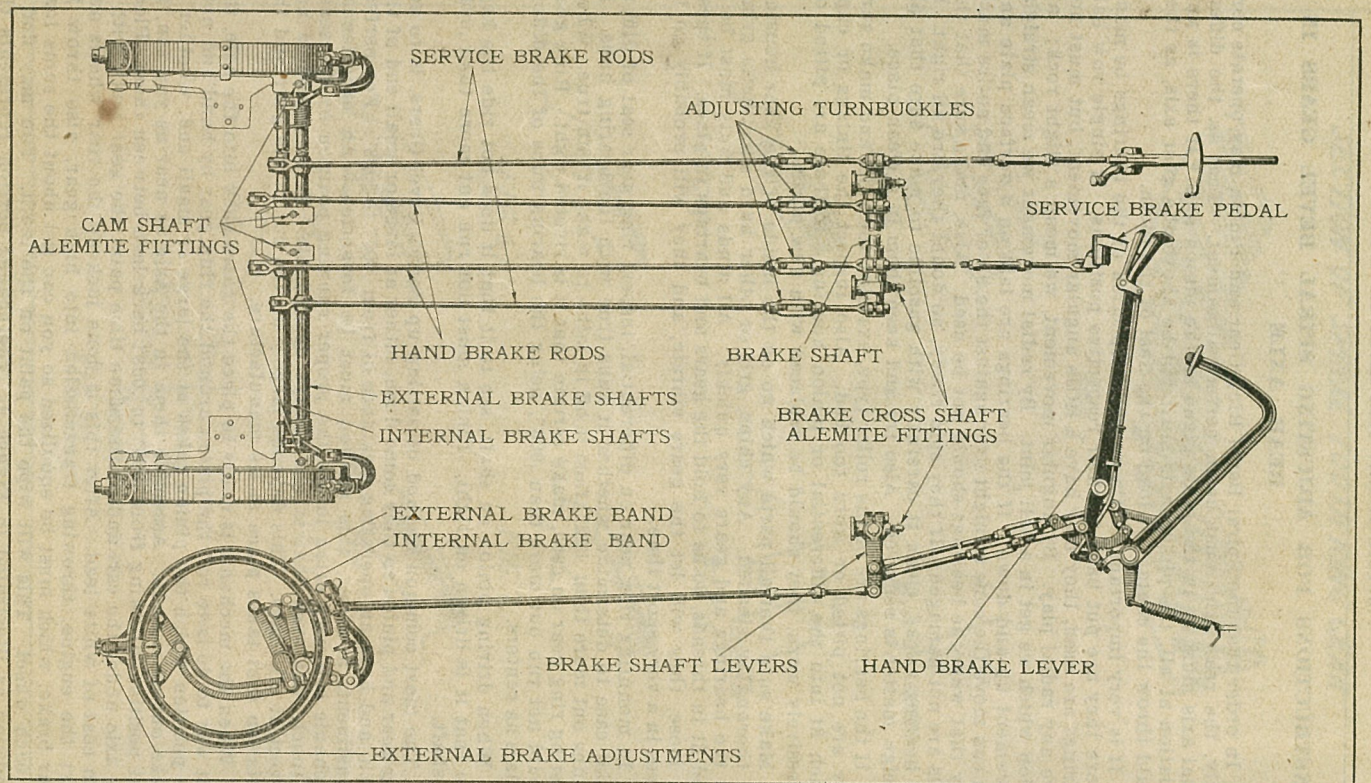


Plate No. 22
Brake Adjustment

three or more notches of your adjusting nut, until the pinion wipes off the paint as shown in shading on Figure 4.

Figure 4 illustrates what we term a desirable contact on the Spiral Tooth Ring Gear. Contact as shown is just a trifle heavier on the toe of the tooth (Figure 2) than it is on the heel. The heel of the gear tooth is the large end, and the toe is the small end. We intend to set the gears in this way, so as to be sure that we get an even contact when a full load is applied; the pinion in that case always having a tendency to lift.

If you have a contact as illustrated in Figure 8 or where the load comes on what we term the flank of the gear tooth, it means that the pinion is too far in toward the axle. Gears set up in this way are noisy. To correct, pull pinion out until contact comes to the full working depth of gear tooth, without leaving lowest point of contact (See Figure 4). If the contact is as shown in Figures 8 and 9, it should only be changed by moving the pinion. If the load is centered in this place, you always find that you have a noisy axle. Noise almost always can be eliminated by the pinion adjustment.

If the contact on tooth appears as shown by shading in Figure 6, it means that there is too much back lash between the Ring Gear and Pinion. Gears set up this way will eventually break off at the heel. To correct, move ring gear toward pinion, but make sure there is back lash, as gears cannot run tight. If the contact still shows heavy on the heel, the large end of the gear (see Figure 2), change the gears. If you still have that contact, the axle is machined wrong or sprung.

Contact as shown in Figure No. 7; that is, heavy on the small end, or the toe of the tooth is not bad, although it doesn't want to be centered there too much. Gears set up this way will eventually break off at the toe. To correct, move ring gear away from pinion. Under no circumstances should the gear pass with a heavy contact on the heel.

Figure 10 illustrates two cones, which spiral bevel gears really are. It illustrates to you the difference you get in back lash, by moving either the ring gear or the pinion the same amount. For example, on a 4:1 gear ratio, it would be necessary to move the pinion four times as much as the ring gear, in order to get the same amount of back lash. So when it is necessary to increase or decrease back lash very much it is best to try to move the ring gear. However, you can tell from your contact just which of the two gears to move.

When the gears are adjusted in this manner under the car, and you feel sure that you have them set up as good as you can make them, you may run the car out on the road and give it a one mile test without putting oil in the axle housing. This will tell you what can be expected, as far as noise is concerned. Oil will not deaden the noise very much; it only acts as a lubricant. If you find it advisable to make further adjustments to make axle quieter, before filling up case with oil and turning car over to the customer, paint the gears up again and make certain that you have contact as illustrated in Figure 4. Full tooth contact is necessary to carry the load.

While this method may seem complicated at first, with a little practice a good mechanic can set up gears in the above manner almost as easy as by-guess work, and it certainly will give a lot more satisfaction to the owner of the car.

WHEEL HUBS

Driving flanges are keyed to the outer ends of the axle shafts and bolted to the wheel hubs, which run on double row ball bearings mounted on the outer ends of the axle tubes, so that all of the weight of the car is carried by the housing, and the axle shafts transmit only the driving effort. The hub bearings are lubricated with cup grease introduced through a filler plug hole in each hub. The hubs are also provided with

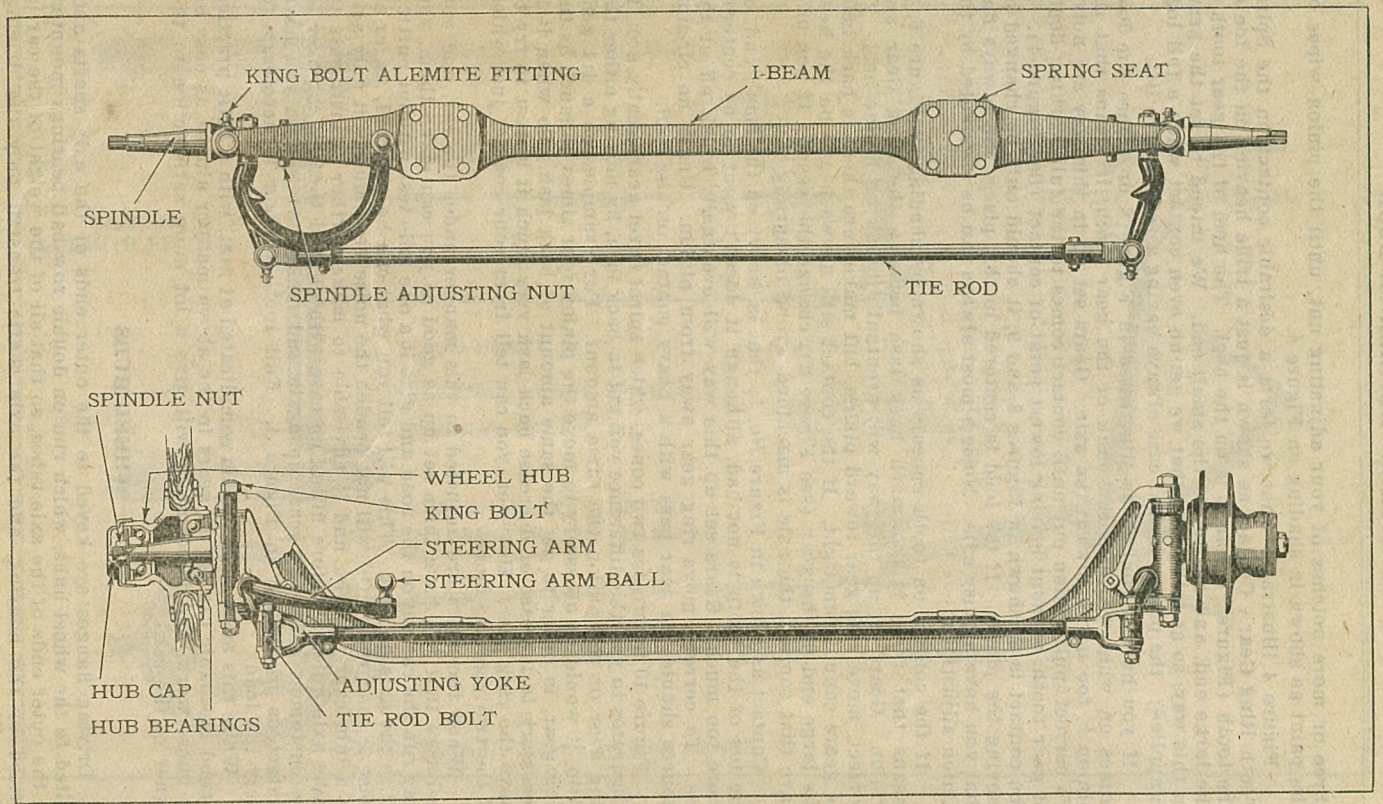


Plate No. 23
Front Axle

felt washers and oil deflectors which throw off any oil which might work out from the differential and prevent it from getting on the brake. This surplus oil or grease is drained off through a drain tube which projects from the inner side of the brake flange underneath the axle tube. **CARE SHOULD BE EXERCISED TO SEE THAT THESE TUBES ARE ALWAYS OPEN AND CLEAN.**

BRAKES

The brakes are supported by brake spiders attached to the main tubes of the axle and are operated by the brake cam shafts. They consist of steel bands lined with friction fabric and so arranged that they can be expanded or contracted against the circumference of the brake drums by means of a pedal or lever.

SERVICE BRAKES

The external or service brakes are operated by the right pedal in the driving compartment. Wear of the brake lining can be taken up by adjustment of the adjusting screw in the anchor pin at the rear and the lock nuts at the lower part of the opening in the band and the thumbscrew, adjustment to be made in the order given. The bands should be adjusted to allow a uniform clearance of 1/32 inch between the lining and the circumference of the drum, when the brakes are released. The throw of the brake levers and the position of the pedal can be adjusted by means of the turnbuckles on the brake rods.

See that brakes on both wheels are adjusted alike.

EMERGENCY BRAKES

The emergency brakes are the internal brakes and are operated by the hand brake lever in the driving compartment. They are seldom used and hence wear very slowly, but when adjustment is necessary, it can be made by shortening the rods with the turn-buckles.

SPRING SEATS

The rear springs are attached to the rear axle by means of spring seats which are free to turn on the axle hub. The spring seats are provided with Alemite fittings and should be filled with soft cup grease at least once every 500 miles.

FRONT AXLE

The front wheels are mounted on steering knuckles pivoted to the front axle, so that they may be turned by the steering gear. Steering arms attached to the knuckles are connected by an adjustable tie rod, and the left steering arm has a third arm which connects to the steering gear by means of the steering connecting rod.

TIE ROD ADJUSTMENT

The front wheels do not stand exactly square but are set at an angle which makes the car steer easily. This angle can be adjusted by means of the adjusting yokes on the tie rod. When properly adjusted, the wheels should measure ¼ to ⅜ inch closer together at the front than the rear and 1 7/16 inch closer at the bottom than at the top, these measurements being taken between the inner sides of the steel felloes.

FRONT HUBS

The front wheels run on proper bearings, which are lubricated through a grease plug on the hub flange, and by filling the hub caps with soft cup grease. In mounting the front wheels, care should be exercised to thoroughly fill the bearings with grease, and also the space between the bearings. The best lubricant for front wheel bearings is a straight mineral

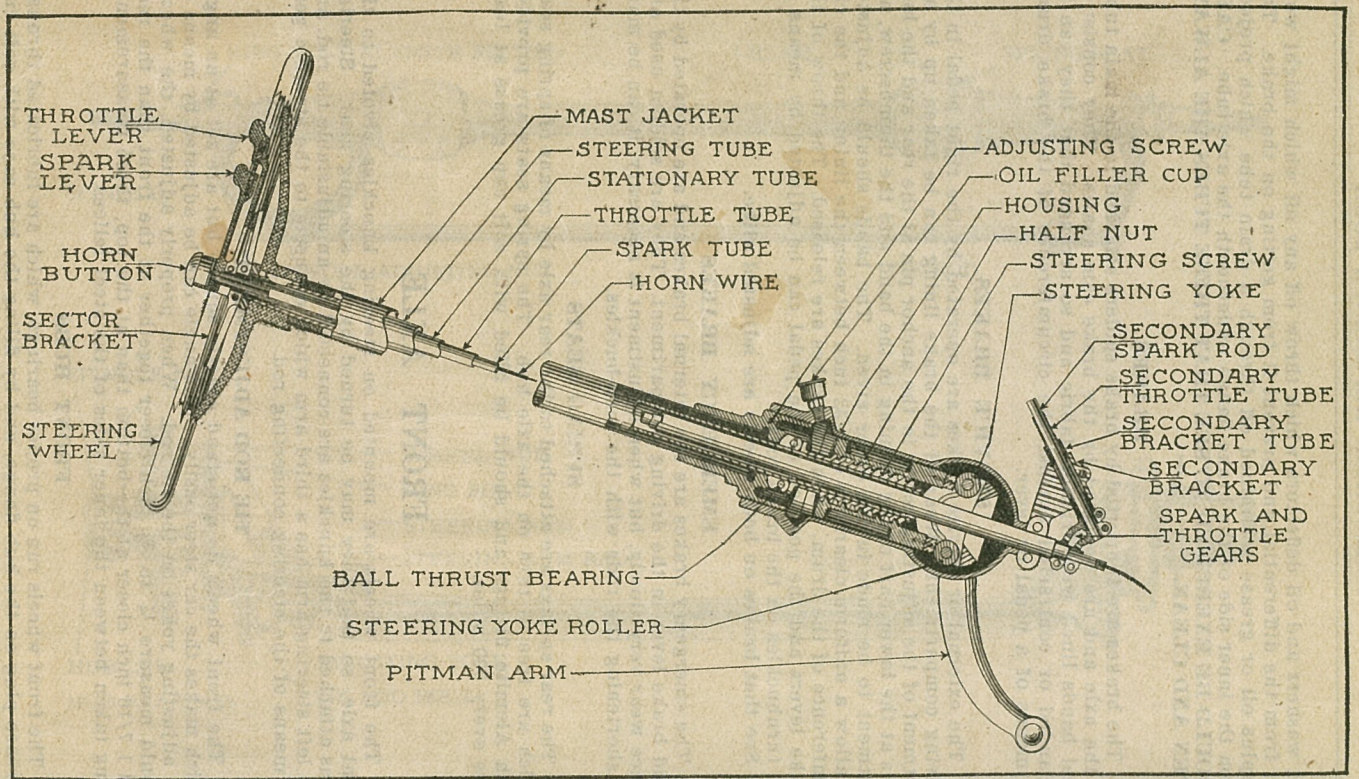


Plate No. 24
Steering Gear

grease which does not contain any free acid or acid forming compounds and which is also entirely free from graphite, asbestos, fibre and other foreign matter.

There are two bearings to each front wheel and these are held in adjustment by the spindle nut, which is fastened with a cotter and a safety washer. which is interposed between the spindle nut and the cone of the outer bearing. The bearings should be adjusted by drawing the spindle nut up tightly, revolve the wheel a few times to insure that all parts are properly seated, at the same time tapping the safety washer lightly to insure a proper contact with the outer bearing. The wheel will now revolve somewhat stiffly, and proper adjustment can be obtained by backing off the spindle nut two cotter pin slots. Lock the nut at this point with the cotter and test the adjustment by spinning the wheel. The wheel should rotate freely but without perceptible shake, and in testing for the shake it is advisable to insert a chisel or small bar between the steering knuckle and the axle, to insure that any play in the king bolt is not confused with play in the bearings.

These adjustments should be made by a competent mechanic or the car taken to the nearest McLaughlin dealer or service station.

STEERING GEAR

The steering wheel is attached to a long tube, the lower end of which carries a double threaded worm or screw, engaging with two half nuts which slide up and down in guides in the steering gear housing. The threads on the steering screw are right and left hand, and one of the half nuts has a right hand thread; the other a left hand thread. When the steering wheel is turned, one of the half nuts rises in its guide while the other is forced downward. At their lower ends the half nuts carry hardened steel thrust blocks which push against rollers attached to the steering yoke, and by their motion the yoke is tilted in the housing, moving the steering pitman arm backward and forward, and by means of the steering connecting rod, turning the front wheels to one side or the other.

The steering screw is provided with a ball thrust bearing and adjusting nut at its upper end for the purpose of taking up any backlash or lost motion in the steering wheel. For best results the steering wheel should not have over one inch of lost motion at wheel rim.

An oiling cup is provided in the steering gear housing, and the housing should be kept filled with heavy steam cylinder oil.

The sector bracket which carries the spark and throttle levers on top of the steering wheel is supported by a stationary tube inside the steering tube. The spark and throttle connections are operated by small concentric tubes enclosed in the stationary tube and carrying bevel gears at their lower ends. The horn button is located in the center of the steering wheel and is connected with the horn by a wire through the center of the inner tube.

SPRINGS

The springs are interposed between the axles and the frame to absorb road shocks before they are transmitted to the remainder of the mechanism or to the passengers.

The front springs are attached to the frame at both ends and to the axle in the center, while the rear springs attach to the frame at their centers and front ends and carry the axle on their rear ends.

The springs are provided with Alemite fittings at their ends and these should be filled with soft cup grease every 500 miles.

Squeaking springs can be overcome by jacking up frame of car to release weight on springs and thin oil applied between leaves or springs